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Several traits are considered economically important when measuring the "profitability" of swine. Profitable swine are those which will return the most to all people associated with the industry. The ultimate goal should be the production of quality pork carcasses that meet the desire of the consumer.

Justification for deciding which traits to measure in the live hog depends upon the heritability of the trait (measure of differences due to genetics) and the relative economic importance of the trait. The swine producer, as well as the seedstock supplier for the producer, determine the kinds of hogs and resulting carcasses which will be available for marketing, packer and retail personnel to merchandise.

What are the traits that affect the economics of these swine-related industries as well as the producer? The traits are: muscularity, prolificacy, growth rate, feed conversion, structural soundness, and backfat. They range in heritability from low (prolificacy) to medium (growth-rate, muscularity, feed conversion, structural soundness and backfat). The relative economic importance of the traits vary according to the section of the swine industry in question.

This publication will deal only with backfat determinations in live hogs and its relationship to the goal of producing quality pork carcasses in volume.

Table 1 shows the average carcass measurements, listed by various classes of average carcass backfats, for 4000 hogs evaluated through Indiana Swine Evaluation Station from 1957 to 1969. The values in the table show, with comparable weight carcasses, that each additional 1.0 inch of carcass backfat results in a decrease of about 5 percent (7 pounds) in ham and loin. This gives some idea of the importance of additional backfat on the 160-pound carcass from a 230-pound live hog.

Table 1. Average Carcass Measurements for Various Backfat Classes.*

Carcass backfat range	Number	Average backfat	Carcass length	Loineye area	Per cent ham-loin**
in.		in.	in.	sq. in.	pct.
Below .99	35	.91	29.7	4.77	40.2
1.00-1.09	117	1.03	29.7	4.75	39.9
1.10-1.19	273	1.13	29.7	4.77	39.1
1.20-1.29	627	1.23	29.7	4.76	38.6
1.30-1.39	819	1.33	29.7	4.76	38.1
1.40-1.49	770	1.43	29.7	4.74	37.6
1.50-1.59	662	1.52	29.7	4.75	37.1
1.60-1.69	359	1.62	29.7	4.74	36.7
1.70-1.79	196	1.72	29.7	4.73	36.0
1.80-1.89	94	1.82	29.6	4.72	35.5
Over 1.90	49	1.95	29.7	4.71	35.4

*From Indiana Swine Evaluation Station data. **Includes trimmed hams and loins as percent of chilled carcass.

VISUAL APPRAISAL METHOD

The first method (and, in many cases, the only method used in determining backfat on the live hog) is that of visual appraisal. This method has resulted in definite changes in backfat in swine.

Visual appraisal is the basis for the many live swine judging shows or evaluation clinics that are now presented. In these shows or clinics, fat cover is incorporated with a mental index with such items as balance, constitution, underline, muscularity and bone. In general, the more muscular, more desirably boned, more nicely balanced animals with the smaller backfat estimate will be chosen.

Visual appraisal for degree of backfat, even though it is easy and cheap to obtain, is not the most accurate method. If it were, the other methods which will be discussed would not have been developed.

MECHANICAL METHODS

Several mechanical methods used by producers in determining backfat on the live hog have been made available within the past 15 to 20 years. Each of these methods—the probe, the leanmeter and the sonoray—requires hog restraint. The probe and leanmeter may be used with the hog restrained by the snare; but with the sonoray, the animal must be restrained with all four feet off the ground.

The probe and leanmeter were developed to obtain objective measures of backfat. The sonoray is used to determine backfat as well as loin-eye area.

Several research reports dealing with live hog backfat determinations have shown that there are three readily identified spots that may be used to get a backfat "reading" on the live animal. These spots are 2 inches off the mid-line at: (1) *the shoulder*—that point straight up behind the front leg, (2) *the back*—junction of the last rib, and (3) *the loin*—lumbar area at a point vertical to the stifle joint (see Figure 1). Note that these three locations correspond to the three locations where backfat determinations are made on the carcass.

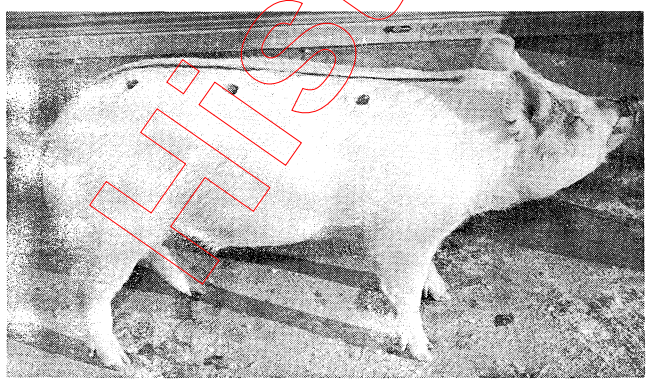

Figure 1. Locations for live hog backfat determinations.

Probing

The probing tools and technique are shown in Figures 2, 3 and 4. The technique requires making a small incision in the skin (Figure 3), after having disinfected the scalpel and incision site with alcohol or any good disinfectant; then using the small metal ruler, calibrated in tenths of an inch, to measure the backfat (Figure 4). The probe site should be disinfected again after the animal has been probed.

The readings at the three locations are totaled. The adjusted backfat at 230 pounds may be determined by using the average of the three probes and the actual weight of the pig when probed. The adjusted probes for various weights and averages of actual probes are presented in Table 2.

Leanmeter

Locations for fat determinations with the leanmeter are the same as with the probe. This tool is somewhat more sophisticated than the probe (Figures 5 and 6). The method is based on the difference in electrical conductivity of fat and muscle. Fat is a relatively poor conductor, while muscle and blood are good conductors. The fat depth is read in tenths of an inch with the leanmeter.

Figure 2. Equipment for the probe technique—snare, disinfectant, scalpel and metal ruler.

As with the probe, adjusted backfat at 230 pounds may be obtained from Table 2 by using the average of the three leanmeter readings and the pig weight when measured.

Sonoray

The sonoray machine employs the "pulse-echo" technique (Figure 7). This is basically the generation of very short bursts of high frequency (nondestructive, inaudible) sound into the animal, detecting the reflection of the pulses, and measuring the elapsed time between introduction of the sound pulse into the animal and the return of the reflected pulse.

Before the pulse can be introduced, the area where the reading is taken must be clipped (using surgical clippers) and well oiled. The pulses are sent and received through an apparatus called a transducer (Figure 8), and fat depth is then read directly from a scale on the front of the machine (Figure 9).

Figure 3. Probe incision being made with the scalpel.

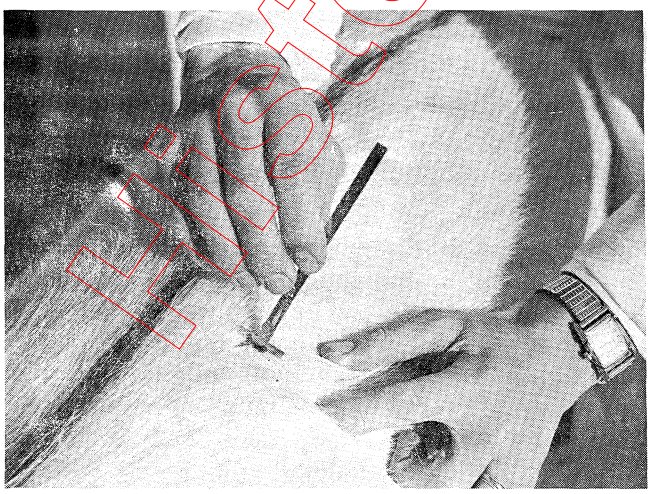

Figure 4. Metal ruler measuring backfat.

Adjusted backfat at 230 pounds may be obtained from Table 2 by using the average of the three sonoray fat readings and the pig weight. The sonoray may also be used to estimate loin-eye area at the last rib. The necessary locations for such estimates are seen in Figure 8.

SUMMARY

Fat determination of the live animal, either by visual appraisal or mechanical methods, should have top priority in the selection of breeding stock. These determinations should be adjusted to a 230-pound basis. Over-fatness, either on the live animal or the carcass, is an industry problem.

Use of the mechanical methods outlined in this publication, whether probe, leanmeter or sonorary, as a supplement to visual appraisal and use of scales, will result in the production of quality pork carcass in volume.

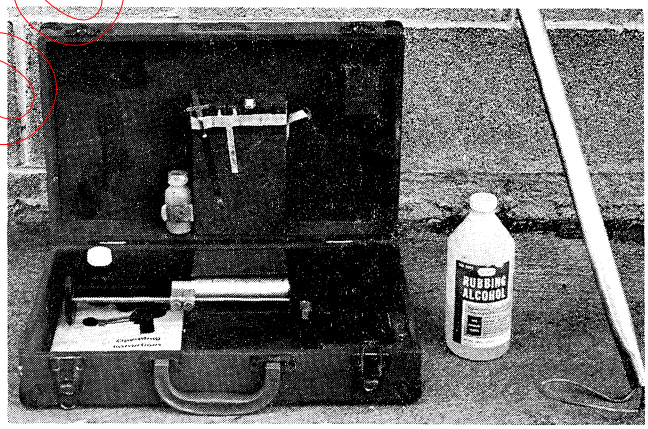

Figure 5. Equipment for leanmeter measurements—snare, disinfectant and leanmeter instrument.

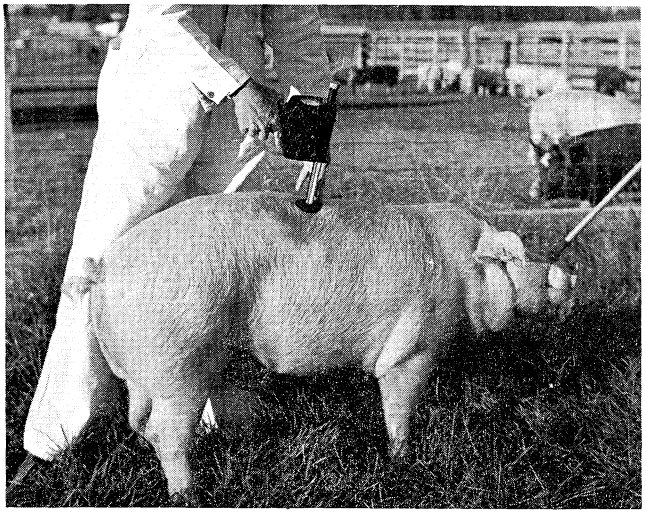

Figure 6. The leanmeter in use.

Figure 7. Equipment for measurement by sonoray—surgical clipper and sonoray machine.

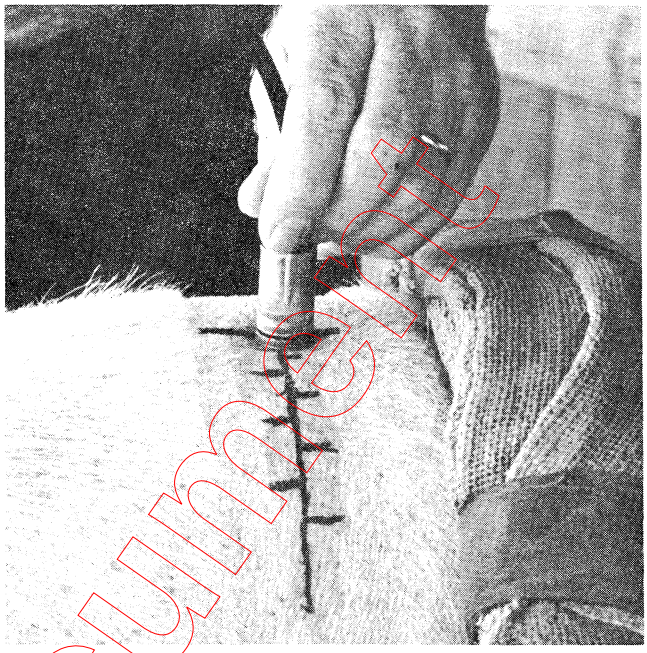

Figure 8. The sonoray transducer and locations where estimated loineye area measurements are taken.

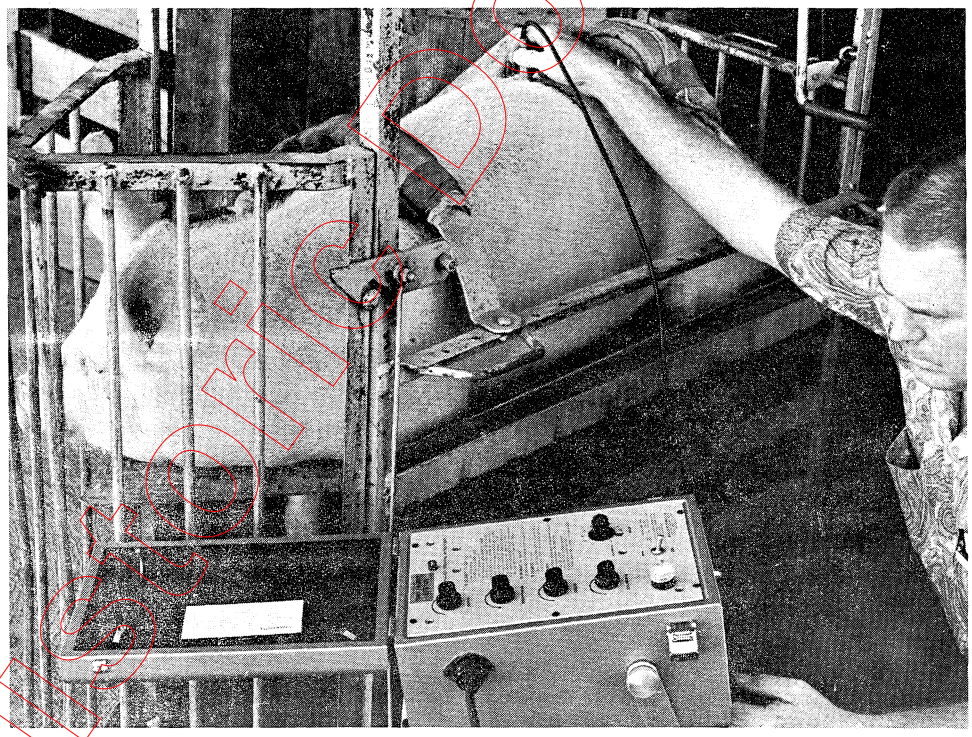

Figure 9. A sonoray in use.

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Table 2. Backfat Adjusted to 230-Pound Live Weight.*

Average actual backfat	Actual weight (in pounds) when measured																		
	190	195	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280
in.										inch									
.40	.46	.46	.45	.44	.43	.42	.42	.41	.40	.39	.38	.38	.37	.36	.35	.34	.34	.33	.32
.45	.52	.51	.50	.50	.49	.48	.47	.46	.45	.44	.43	.42	.41	.41	.40	.39	.38	.37	.36
.50	.58	.57	.56	.55	.54	.53	.52	.51	.50	.49	.48	.47	.46	.45	.44	.43	.42	.41	.40
.55	.64	.63	.62	.61	.59	.58	.57	.56	.55	.54	.53	.52	.51	.50	.48	.47	.46	.45	.44
.60	.70	.68	.67	.66	.65	.64	.62	.61	.60	.59	.58	.56	.55	.54	.53	.52	.50	.49	.48
.65	.75	.74	.73	.72	.70	.69	.68	.66	.65	.64	.62	.61	.60	.59	.57	.56	.55	.53	.52
.70	.81	.78	.78	.77	.76	.74	.73	.71	.70	.69	.67	.66	.64	.63	.62	.60	.59	.57	.56
.75	.87	.86	.84	.83	.81	.80	.78	.77	.75	.74	.72	.71	.69	.68	.66	.65	.63	.62	.60
.80	.93	.91	.90	.88	.86	.85	.83	.82	.80	.78	.77	.75	.74	.72	.70	.69	.67	.66	.64
.85	.99	.97	.95	.94	.92	.90	.88	.87	.85	.83	.82	.80	.78	.77	.75	.73	.71	.70	.68
.90	1.04	1.03	1.01	.99	.97	.95	.94	.92	.90	.88	.86	.85	.83	.81	.79	.77	.76	.74	.72
.95	1.10	1.08	1.06	1.05	1.03	1.01	.99	.97	.95	.93	.91	.89	.87	.86	.84	.82	.80	.78	.76
1.00	1.16	1.14	1.12	1.10	1.08	1.06	1.04	1.02	1.00	.98	.96	.94	.92	.90	.88	.86	.84	.82	.80
1.05	1.22	1.20	1.18	1.16	1.13	1.11	1.09	1.07	1.05	1.03	1.01	.99	.97	.95	.92	.90	.88	.86	.84
1.10	1.28	1.25	1.23	1.21	1.19	1.17	1.14	1.12	1.10	1.08	1.06	1.03	1.01	.99	.97	.95	.92	.90	.88
1.15	1.33	1.31	1.29	1.27	1.24	1.22	1.20	1.17	1.15	1.13	1.10	1.08	1.06	1.04	1.01	.99	.97	.94	.92
1.20	1.39	1.37	1.35	1.32	1.30	1.27	1.25	1.22	1.20	1.18	1.15	1.13	1.10	1.08	1.06	1.03	1.01	.98	.96
1.25	1.45	1.43	1.40	1.38	1.35	1.33	1.30	1.28	1.25	1.23	1.20	1.18	1.15	1.13	1.10	1.08	1.05	1.03	1.00
1.30	1.51	1.48	1.46	1.43	1.40	1.38	1.35	1.33	1.30	1.27	1.25	1.22	1.20	1.17	1.14	1.12	1.09	1.07	1.04
1.35	1.57	1.54	1.51	1.49	1.46	1.43	1.40	1.38	1.35	1.32	1.30	1.27	1.24	1.22	1.19	1.16	1.13	1.11	1.08
1.40	1.62	1.60	1.57	1.54	1.51	1.48	1.46	1.43	1.40	1.37	1.34	1.32	1.29	1.26	1.23	1.20	1.18	1.15	1.12
1.45	1.68	1.65	1.62	1.60	1.57	1.54	1.51	1.48	1.45	1.42	1.39	1.36	1.33	1.31	1.28	1.25	1.22	1.19	1.16
1.50	1.74	1.71	1.68	1.65	1.62	1.59	1.56	1.53	1.50	1.47	1.44	1.41	1.38	1.35	1.32	1.29	1.26	1.23	1.20
1.55	1.80	1.77	1.74	1.71	1.67	1.64	1.61	1.58	1.55	1.52	1.49	1.46	1.43	1.40	1.36	1.33	1.30	1.27	1.24
1.60	1.86	1.82	1.79	1.76	1.73	1.70	1.66	1.63	1.60	1.57	1.54	1.50	1.47	1.44	1.41	1.38	1.34	1.31	1.28

* Adjusted backfat = [(230 - actual weight) x .004) + 1.0] x average actual backfat